



Atty. Dkt. No. 051583-0249

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Shabbir AHMED and Michael
KRUMPELT

Title: IMPROVED PROCESS FOR
GENERATING HYDROGEN FOR
FUEL CELLS

Appl. No.: 09/816,694

Filing Date: 03/23/2001

Examiner: Marian Knode

Art Unit: 1764

DECLARATION UNDER 37 C.F.R. §1.132 OF SHABBIR AHMED

I, Shabbir Ahmed, state and declare that:

1. I am a citizen of the United States of America, residing at 2843 Fairhauser Court, Naperville, Illinois 60564.

2. I am an employee of Argonne National Laboratories, Argonne, IL.

3. I have a Ph.D. in Chemical Engineering and 15 years of experience in the field of fuel cell technology. Given my experience and background, I believe that I possess at least a level of ordinary skill in the art.

4. I am a co-inventor of the cited reference, U.S. Patent No. 5,929,286 ("Krumpelt"). I am a co-author of the cited references, "The Low-Temperature Partial-Oxidation Reforming of Fuels for Transportation Fuel Cell Systems" (1996 Fuel Cell Seminar Abstracts, November 17-20, 1996, Orlando, Florida, pp. 750-753); and "Catalytic Partial Oxidation Reforming of Hydrocarbon Fuels," (Fuel Cell Seminar Abstracts, November 16-19, 200, Palm Springs, California, pp. 242-245) (collectively, "the publications").

5. I am a co-inventor of U.S. Application Serial No. 09/816,694, filed March 23, 2001 ("the application"). I have reviewed the final Office Action mailed December 1, 2004, and the prior art cited therein.

6. At the time of the publication of the cited references, I and my colleagues at Argonne were among the few groups in the world working to improve autothermal reforming reactions for the production of hydrogen, particularly in the area of new catalysts that could accelerate the autothermal reforming reaction.

7. The field was, at the time of the publications, a highly empirical one and remains so today. Many variables must be addressed in designing an autothermal reforming reactor and partial oxidation process. For example, at least the following variables must be taken into account: the definition of the fuel or mixture of fuels used; the design and choice of catalysts; the choice of temperature range needed for sufficient conversion, the range of the oxygen-to-fuel ratio; and the range of the water-to-fuel ratio. We tried to establish sophisticated models for these reactions, but the lack of kinetics for the different catalyst systems forced us toward an experimental approach. By comparing the operating conditions to the thermoneutral point, we finally realized this parameter can serve as a pivot point for determining operating conditions. The experimental data was then used to define the operating range around the thermoneutral point.

8. Once we had worked out the relationship between the thermoneutral point and the O_2 :fuel ratio (x) using the heats of formation of fuel and water, we still needed to determine the range of appropriate x_0 values for x . This could not be done through calculation alone, but by an iterative process of modeling and experimentation. We eventually found the optimal value of x in our method to lie between about $0.5x_0$ and $1.5x_0$.

9. Our method, therefore, teaches a combination of conditions that will lead to desirable operating conditions, without requiring modeling or excessive experimental iterations. The ranges proposed in the claims are based on theory and experiment and were not

arbitrarily chosen by us. As a co-inventor/co-author of the cited references, I believe my group and I knew about the contents of the cited references and it was not obvious to us at the time of our publications and patent filing that our research would lead to a method that could be correlated to the experimentally determined operating conditions as nicely as it did. It took us a lot of hard work to discover our claimed methods and that endeavor was not a simple matter of running a few routine experiments.

10. Our invention is now being used by a private sector company which is interested in licensing our technology.

11. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or of any patent resulting therefrom.

Date: 3/1/2005

By: Shabbir Ahmed
Shabbir Ahmed